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## A Summary of our Present Knowledge of the Ferns of the Philippines

BY LUCIEN MARCUS UNDERWOOD

Linnaeus included a single fern from the Philippines in the first edition of his *Species Plantarum*. This was called *Adiantum Philippense* and was based on a figure of Petiver, who seems to be the sole authority for the source of the fern. Hooker referred the plant with some hesitation to *A. caudatum*, which appears to be a common species in the islands. The early European travelers collected a few ferns in the Philippines, some of which were described by Cavanilles early in the last century; the types of these species are presumably at Madrid. Chamisso included the Philippines in his travels and Kaulfuss described several Philippine ferns in his *Enumeratio* (1824). Presl described a number collected by Thaddeus Haenke and by Née in his *Reliquiae Haenkeanae* (1830) and others still from the same collectors in *Epimeliae Botanicae* (1849). Gaudichaud also visited Luzon and collected a few species. It was not, however, until 1836-40 that any considerable collection was made in the islands, when Hugh Cuming, an English botanical traveler, visited the Philippines and brought back an extensive collection of ferns which were studied by John Smith, of Kew Gardens. Smith published a list of these ferns\* which included 297 species, of which he estimated that 100 were new to science. He gave names to his new species but they remained *nomina nuda* until they were described in part by Hooker in *Species Filicum* (1844-1866), and in part by Presl in his *Hymenophyllaceae* (1843) and in his *Epimeliae Botanicae* (1849) and other works. The types of these species are therefore divided between the Royal Herbarium at Kew and the herbarium of the Deutsches Botanisches Institut at Prague. The most complete series of Cuming's collections is at Kew, but extensive duplicate series exist in other herbaria. The types of Haenke's collections are at Prague, where Presl's rich fern collection exists, unmounted, just as its

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\* Smith, John. *Enumeratio Filicum Philippinarum*. Jour. Bot. 3 : 392-422. 1841.

founder left it. A few ferns were collected by Vidal and included in his *Revisión* (1886), and his *Catálogo* (1892) both printed at Manila, but these works contained no additions to the fern flora and their determinations are to say the least of doubtful value.

More important were the collections of Professor J. B. Steere, of Michigan University, who visited the islands between 1870 and 1875. The ferns of the Steere collection were worked over at Kew by M. W. Harrington,\* who described a few species as new and made numerous additions to the known flora. The originals of the Steere collection are at Michigan University and a fair series of duplicates is at Kew.

A still more important collection of Philippine ferns was made in the years 1890-97 by A. Loher, a Bavarian traveler, which was almost as extensive as the earlier one of Cuming. Dr. H. Christ,† of Basel, studied Loher's collection, and his enumeration comprises 271 species, including many additions to the known flora and a number of new species.

Finally Herr O. Warburg, who has for years made a special study of the flora of the monsoon region, traveled in Luzon and the southern portion of Mindanao and made extensive collections. His ferns were studied by Dr. Christ and are listed in the first volume of *Monsunia*,‡ where Dr. Warburg has also given an extended revision of the species of *Selaginella* of the entire Indo-Pacific region from Japan to Australia. Many species were thus added to the Philippine flora, including quite a number of new species, especially in *Selaginella*.

The fern flora of the Philippines as known to-day embraces over 600 species, and it may be said that collection has only commenced. It is probable that when the area is fully explored the extensive archipelago so lately come into our possession will yield at least half as many more species. In order to furnish our botanical residents and travelers in the Philippines a means of un-

\* Harrington, M. W. The Tropical Ferns collected by Professor Steere in the years 1870-75. Jour. Linn. Soc. 16: 25-37. 1877.

† Christ, H. Filices Insularum Philippinarum. Bull. Herb. Boiss. 6: 127-154, 189-211. pl. 2-4. 1898.

‡ Warburg, O. Monsunia, Vol. 1, 1900. Filicinae, by H. Christ, pp. 54-94. pl. 2; Rhizocarpaceae, Equisetaceae, Lycopodiaceae and Selaginellaceae, by O. Warburg, pp. 95-136. pl. 3, 4.

derstanding the relations of the fern flora of these islands, at least generically, we have prepared the following synopses of the genera known to exist in the islands, which include many forms widely different either from our own temperate ferns, or even from the ferns of the American tropics. The generic sequence here adopted will be found to differ widely from the treatment given in Hooker and Baker's *Synopsis Filicum* (1874), which unfortunately remains the only hand manual of the ferns of all lands and whose treatment of genera is as irrational as its recognition of specific distinctions is defective, generalized and indefinite. The system here adopted will accord more nearly with the treatment by Dr. Diels in *Die natürlichen Pflanzenfamilien*, which in the main is admirable, suffering lapses to the older system mainly in its treatment of the Cyatheaceae and the genera included under *Polypodium* and *Nephrodium*. In the Hymenophyllaceae we have followed in part the admirable treatment of Presl \* which, in the main, was taken up by Van den Bosch, the only other monographer who has made a special study of the group, and which has been as systematically neglected by Hooker and Baker and by Sadebeck, who prepared this family for *Die natürlichen Pflanzenfamilien*. For convenience, references are here made to the *Synopsis Filicum* and *Die natürlichen Pflanzenfamilien*, where the treatment differs from either of the works named.

While the fern flora of the Philippines is only partially known, it is probable that there will be very few additions to the genera as the result of further exploration. With the exception of the Isoetales — usually the last pteridophytes to be collected in any region — all the orders are represented in the Philippine flora and among the Filicales all the families except the rare and unique Matoniaceae; from the known distribution of the two diverse species of this family it is not improbable that it will ultimately find a representative in our domain. Since the present synopsis is intended chiefly to aid in distinguishing generically the ferns that may be collected in the islands, suggestions are given here and there relative to special points to be noted in the field, since in many genera certain portions of the plant show more important

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\* Presl, C. B. Hymenophyllaceae. Eine botanische Abhandlung. 1-70. *pl.* 1-12. Prag, 1843.

diagnostic characters than others and need to be specially noted in the field, particularly in plants too large to be collected entire. A few general features should always be noted and these are here summarized :

1. In all ferns not over two feet high an entire plant should be secured, but in plants growing in dense crowns the rootstock may well be split lengthwise and several of the leaves removed before drying.

2. In all ferns not over four feet high an entire leaf should be secured if possible attached to the rootstock or to some portion of it. In case of very wide leaves the lower pinnae on one side may be cut away to prevent the too great massing of foliage when the leaf is doubled on itself to make a manageable specimen.

3. In tree-ferns the basal portion of the petiole should always be secured, if possible, attached to the lower pinnules. Where possible the top of the caudex should also be taken. Notes on the character of the leaf-scars should always be made.

4. If the specimen taken does not show whether the leaves are scattered or cespitose this fact should always be included in the notes.

5. In ferns of whatever size, invariably secure some portion of the rootstock, for it nearly always possesses diagnostic characters.

6. In large leaves note whether the lowermost pinnae are larger than the others or are reduced in size and if their laminae stand in the same plane as the rest of the leaf or are set obliquely.

Had the earlier collectors followed such directions instead of taking mere tips of large leaves, or single leaves of smaller ferns wholly without rootstocks, we would now be saved the uncertainty of identifying plants with descriptions based on such scrappy materials.

The six orders represented in the Philippines may be distinguished as follows :

- |   |                          |
|---|--------------------------|
| I. Plants of fern-like habit, mostly with broad leaves.   | 2.                       |
| Plants of rush-like habit ; foliage reduced to whorls of united scales forming sheaths at the joints of the stems ; sporangia borne under peltate shields collected in a terminal cone. |                          |
|   | V. <b>Equisetales.</b>   |
| Plants of moss-like habit, with 4-10-ranked scale-like or linear leaves, terrestrial or epiphytic ; sporangia borne in the axils of ordinary or modified leaves.                        |                          |
|   | VI. <b>Lycopodiales.</b> |

2. Homosporous (spores uniform) ; all terrestrial or epiphytic except *Ceratopteris*. 3.  
Heterosporous (producing minute microspores and larger macrospores) ; aquatic,  
rooted or floating ; sporangia borne in ovoid or spherical conceptacles (*sporocarps*).  
IV. **Salviniales**.
3. Sporangia on the under surface of the leaf, borne in boat-shaped or circular concep-  
tacles (*synangia*) ; eusporangiate ; vernation circinate. II. **Marattiales**.  
Sporangia borne in sori directly on the veins or exceptionally in spikes or panicles. 4.
4. Vernation erect or inclined ; eusporangiate, the sporangia ringless, leathery, open-  
ing by a transverse slit, arranged in spikes or panicles. I. **Ophioglossales**.  
Vernation circinate ; leptosporangiate, the sporangia membranous, usually provided  
with a ring which opens elastically. III. **Filicales**.

#### I. OPHIOGLOSSALES

The fleshy plants of this order making up the single family Ophioglossaceae are arranged in four genera.

1. Terrestrial plants. 2.  
Epiphytic, pendent from trees ; leaf strap-like, bearing a spike near the middle.  
OPHIODERMA.
2. Sporangia in two-ranked spikes ; leaves simple ; veins anastomosing.  
OPHIOGLOSSUM.
- Sporangia in panicles ; leaves compound ; veins free. 3.
3. Panicles lax, the sporangia 2-ranked. BOTRYCHIUM.  
Panicles close, spike-like ; the sporangia clustered and crested.  
HELMINTHOSTACHYS.

The members of this family are mostly small plants and the species of *Ophioglossum* especially would be likely to be overlooked. Four species of *Ophioglossum* are already known and the other genera are each represented in the islands by a single species. *Ophioderma* has leaves a yard or more long ; it is often united to *Ophioglossum*, but in both habit and structure it is abundantly distinct.

#### II. MARATTIALES

The members of the tropical family Marattiaceae are mostly large fleshy plants with stout stems rising from ponderous corm-like trunks. There are three genera known from the Philippines :

1. Leaves ternate or palmate ; synangia circular, depressed in the center. KAULFUSSIA.  
Leaves pinnately compound ; synangia oval or boat-shaped. 2.
2. Capsules concrete in boat-shaped synangia. MARATTIA.  
Capsules close but not concrete, collected in oval sori. ANGIOPTERIS.

*Kaulfussia* is represented by a single small species with leaves resembling those of the horse-chestnut. *Marattia* has two with

bipinnate or tripinnate leaves eight to fifteen feet long, while *Angiopteris* has four nominal species \* nearly as large.

### III. FILICALES

The ferns proper with circinate vernation belonging to the leptosporangiate series are represented in the Philippines by several families distinguished as follows:

1. Sporangia opening longitudinally, paniculate (or in *Lygodium* borne singly and covered by scales on narrow projections from the leaves). 2.  
     Sporangia sessile, borne on a special marginal thread-like receptacle, surrounded by a cup-shaped or bivalved involucre; texture translucent. 7. HYMENOPHYLLACEAE.  
     Sporangia dorsal or marginal, attached directly to the lamina, usually collected in definite sori. 3.
2. Sporangia nearly globose with a rudimentary ring. 1. OSMUNDACEAE.  
     Sporangia pyriform with an apical ring. 3. SCHIZAEACEAE.
3. Aquatic; leaves dimorphous; sporangial ring broad or rudimentary. 2. CERATOPTERIDACEAE.  
     Terrestrial or epiphytic; sporangial ring complete, vertical. 4.
4. Sporangia sessile, wedge-shaped, radially arranged; stems simple or (in all Philippine species) pseudo-dichotomous. 4. GLEICHENIACEAE.  
     Sporangia sessile or short-stalked in rounded sori; usually arborescent. 5. CYATHEACEAE.  
     Sporangia usually long-stalked; herbaceous, rarely with an arborescent caudex. 6. POLYPODIACEAE.

To the above families belong the largest number of the ferns not only of the Philippines but of the entire world. While the greater part of the Philippine ferns bear a general resemblance to those of temperate regions there are many curious forms particularly among the epiphytic species that are quite unique and widely different from our ordinary conception of a fern. The two families Gleicheniaceae and the tree-ferns (Cyatheaceae) are not represented in temperate America at all, and the filmies (Hymenophyllaceae), rare with us, are abundantly represented in the Philippines as in all tropical regions.

#### FAMILY I. OSMUNDACEAE

This family is represented in the Philippines by a single species of *Osmunda*, though it is quite possible that others may be found.

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\*Synopsis Filicum reduces all the forms of *Angiopteris* to a single species, but Presl defined ten, and DeVries and Harting who monographed the family in 1853 recognized sixty! From the fleshy nature of the plants it is a genus that requires field study, and description or even identification from herbarium material is necessarily defective.

## FAMILY 2. CERATOPTERIDACEAE

The aquatic *Ceratopteris*, apparently a tropical cosmopolite, is the only known representative of this family.

## FAMILY 3. SCHIZAEACEAE

Four genera of this family have been found in the archipelago; they may be distinguished as follows:

- |   |                |
|---|----------------|
| 1. Sporangia solitary, covered by scales, arranged on marginal teeth of the leaves;<br>leaves pinnate; stems twining. | LYGODIUM.      |
| Sporangia in distichous spikes; plants small, erect.  | 2.             |
| 2. Leaves narrow, simple, grass-like.   | 3.             |
| Leaves broader, flabellately forked.  | LOPHIDIUM.     |
| 3. Spikes in a penicillate tuft.  | ACTINOSTACHYS. |
| Spikes in a pinnate cluster.  | SCHIZAEA.      |

The last three genera, which have usually been united under *Schizaea*,\* are inconspicuous plants represented in the Philippines by one species each. *Lygodium* is represented by six species which are conspicuous climbing ferns very unlike their single diminutive representative in our Eastern States.

## FAMILY 4. GLEICHENIACEAE

This family is well represented in the Philippines by eleven species of *Dicranopteris*; † while this number is nominal it is likely not to be excessive, judging from the diversity of species in other tropical regions. The species are wide-spreading, often forming tangled thickets, and are easily recognized by the pseudo-dichotomous branching. They are very difficult to prepare for the herbarium and the greatest care should be taken to secure representative material, since the apical portions of a branch may be quite unlike the lower part of the same plant. By all means the lowest forking should be included in the specimen.

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\* In case the members of this alliance are grouped as a single genus it must bear the name *Lophidium*, the oldest available name for a member of this group. The three genera, however, are very homogeneous groups and may best be treated as above.

† The § *Mertensia* of Synopsis Filicum has been thought by many, commencing with Willdenow, to be worthy of generic rank, and has often been kept distinct from the typical Australasian species of *Gleichenia*. The name *Mertensia*, however, is not available since there is an earlier *Mertensia* in the Boraginaceae. *Dicranopteris* Bernh. is available for this group and was proposed for what has usually been known as *Gleichenia dichotoma* (*Polypodium dichotomum* Thunb.). *Mecosorus* Hassk. was a later name proposed by its author because of the preoccupation of *Mertensia*.



## FAMILY 5. CYATHEACEAE

The tree-ferns of the Philippines do not appear to have been adequately collected, but the same is true of the family everywhere. They are not a suitable subject for ordinary herbarium study and should be specially prepared as already noted above. The characteristic armature or vestiture of the leafstalks should always be secured and if possible a section of the caudex. The genera represented in the Philippines are as follows:

- |  |            |
|--|------------|
| 1. Sori marginal; indusium coriaceous, 2-valved; herbaceous species. | CIBOTIUM.  |
| Sori dorsal; tree-ferns.   | 2.         |
| 2. Indusium inferior, cup-shaped.                                    | CYATHEA.   |
| Indusium inferior, half cup-shaped.                                  | HEMITELIA. |
| Indusium wanting.  | ALSOPHILA. |

*Cibotium* is represented by *C. Barometz*,\* often cultivated in American conservatories, and is not a tree-fern. The other genera form the genuine tree-ferns and include thirteen known species, four in *Cyathea*, eight in *Alsophila* and a single *Hemitelia*.

## FAMILY 6. POLYPODIACEAE

The true ferns are the most abundant of any family and form three fourths of the fern flora of the islands, which is their usual proportion. The number of genera is so large that we can best distinguish them in their tribal relations separately:

- |  |                           |
|--|---------------------------|
| 1. Sporangia scattered over the under surface of the leaf-blade in a uniform layer.†   | 2.                        |
| Sporangia dorsal or marginal, accumulated in definite sori.  | 3.                        |
| 2. Leaves of two sorts; a shield-like basal leaf attached to the surface of the substratum and a furcate spreading one with localized sporangial surfaces. |                           |
|  | 1. <i>Alcicornieae</i> .‡ |
| Leaves approximately uniform; sporangia covering entire leaves or pinnae.  |                           |
|  | 2. <i>Acrosticheae</i> .  |
| 3. Sori marginal, continuous or interrupted, covered by a more or less modified portion of the leaf-margin. ‡  | 3. <i>Pterideae</i> .     |
| Sori dorsal, or at most submarginal, with or without indusia.  | 4.                        |

\* Included under *Dicksonia* in *Synopsis Filicum*.

† Certain Dryopterideae with confluent sori may be sought here. Cf. *Polybotrya*, *Anapausia*, *Egenolfia*, etc. Their habit is distinctively aspidioid, and lacks the jointed leaf-stalks of the Acrosticheae.

‡ We propose this tribal name for the "stag-horn ferns," believing their unique habit should separate them from the Acrosticheae with which they have usually been associated. The name comes from *Alcicornium* Gaud. (1826), which is an older name than *Platyserium*.

‡ The indusium is wanting in *Notholaena*.

- |  |  |
|--|--|
| 4. Sori elongate-linear.   | 5.                                     |
| Sori round or oval.  | 7.                                     |
| 5. Sori sunken in grooves.   | 3. <i>Vittarieae</i> .                 |
| Sori superficial.  | 6.                                     |
| 6. Indusium normally present (wanting in <i>Coniogramme</i> and <i>Hemionitis</i> ).                     | 6. <i>Asplenieae</i> .                 |
| Indusium wanting.  | Certain anomalous <i>Polypodieae</i> . |
| 7. Leaves and primary venation fan-shaped; secondary venation anastomosing; indusium wanting.            | 7. <i>Dipterideae</i> .*               |
| Leaves and venation normally pinnate.  | 8.                                     |
| 8. Indusium superior or wanting.   | 9.                                     |
| Indusium inferior, rupturing above the sorus.  | 10. <i>Woodsieae</i> .                 |
| Indusium attached internally, opening toward the leaf-margin (wanting in <i>Monachosorum</i> ).          | 11. <i>Davallieae</i> .                |
| 9. Leafstalks jointed at their attachment with the rootstock, leaving definite scars when they separate. | 10.                                    |
| Leafstalks continuous with the rootstock; sori dorsal or terminal on the veins, normally indusiate.      | 8. <i>Dryopterideae</i> .†             |
| 10. Indusium wanting; sori dorsal or terminal.   | 4. <i>Polypodieae</i> .                |
| Indusium present; sori near the base of the veins.   | 9. <i>Oleandreeae</i> .                |

### Tribe 1. *Alcicornieae*

This tribe is represented in the islands by two species of stag-horn fern (*Alcicornium*), characterized by the cordate basal sterile leaves, and the single species of *Cheiropleuria*, with linear sporophylls and two-lobed foliage. Both are epiphytic ferns.

### Tribe 2. *Acrosticheae*

About five species of *Elaphoglossum* with simple free-veined leaves, and a single species of *Acrostichum* with pinnate leaves and anastomosing veins make up the known representation of this tribe in the Philippines. The dense masses of sporangia spread in a uniform layer over the leaves form a character easily recognized.

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\* *Dipteris* in *Synopsis Filicum* was placed in the genus *Polypodium*, with which it has no near alliance, and in *Die natürlichen Pflanzenfamilien* it is placed in the *Aspidieae*, in which it finds an equally insecure resting place. It is a unique fern without near relations and we place it in a distinct tribe.

† Since *Aspidium* as a generic name must be retired to the oblivion of synonymy, it is desirable that we have a tribal name which is derived from a typical or characteristic genus contained in it. We therefore substitute *Dryopterideae* for *Aspidieae* heretofore in use.

*Tribe 3. Vittarieae*

The three Philippine genera of this tribe may be characterized as follows :

- |   |             |
|---|-------------|
| 1. Leaves narrow, grass-like ; sporangia in one or more continuous lines.                 | 2.          |
| Leaves broader ; sporangia in broken lines often following the anastomosing of the veins. | ANTROPHYUM. |
| 2. Sporangial line medial, single.  | MONOGRAMMA. |
| Sporangial lines double, marginal or submarginal.   | VITTARIA.   |

Eight nominal species of *Antrophyum*, six of *Vittaria* and one *Monogramma* have been reported from the Philippines. All are epiphytic in habit.

*Tribe 4. Polypodiace*

Two distinct series are represented in this tribe which normally includes the species lacking an indusium. In one series the sori are linear, in the other they are normally round ranging to oval. The genera may be distinguished as follows :

- |  |                |
|--|----------------|
| 1. Sori linear, parallel to the midrib or margin.  | 2.             |
| Sori linear, oblique to the midrib ; veins anastomosing.   | SELLIGUEA.     |
| Sori round or oval.  | 5.             |
| 2. Leaves simple.  | 3.             |
| Leaves pinnate.  | 4.             |
| 3. Leaves dimorphous, the sporophylls narrow.  | DRYMOGLOSSUM.  |
| Leaves uniform, the apex contracted and bearing the sporangia.   | BELVISIA.*     |
| 4. Sori median, between midrib and margin.   | TAENITIS.      |
| Sori finally covering the entire under surface.  | PLATYTAENIA.   |
| 5. Under surface of leaf densely covered with stellate hairs.  | CYCLOPHORUS.†  |
| Under surface smooth or barely scaly.  | 6.             |
| 6. Veins free.   | POLYPODIUM.    |
| Veins anastomosing.  | 7.             |
| 7. Basal leaves unlike the sporophylls, forming a nest-like cluster at the base of the plant.            | DRYNARIA.      |
| Leaves normally uniform.   | 8.             |
| 8. Sori dorsal, confined to the veins.   | 10.            |
| Sori dorsal, extending to the parenchyma.  | 9.             |
| Sori terminal on the veins and marginal on the leaf ; sporophylls contracted ; root-stocks much swollen. | LECANOPTERIS.  |
| 9. Leaves pinnate.   | PHOTINOPTERIS. |
| Leaves pinnatifid with decurrent segments.   | DRYOSTACHYUM.  |

\* *Belvisia* Mirbel, antedates *Hymenolepis* Kaulf. adopted in *Die natürlichen Pflanzenfamilien* for this genus.

† *Cyclophorus* Desv. was perfectly well characterized and typified, and there is no excuse for using the later *Niphobolus* Kaulf.

10. Areolae regular, with a single free included veinlet which is directed outward.

GONIOPHLEBUM.\*

- Areolae small, irregular, with free veinlets spreading in various directions.

PHYMATODES.\*

*Selliguea*, joined with *Gymnogramme* in *Synopsis Filicum*, and united with *Polypodium* in *Die natürlichen Pflanzenfamilien*, is represented by eight species. *Drymoglossum*, *Dryostachyum*, *Taenitis* and *Platytaenia* have each a single representative in the Philippine flora, the last two in fact being monotypic genera.

*Belvisia*, included under *Acrostichum* in *Synopsis Filicum*, has two representatives. The remaining genera recognized above form a part of the unnatural genus *Polypodium*, as recognized in *Synopsis Filicum*. *Lecanopteris* and *Photinopteris* are represented each by a single species; *Cyclophorus* has sixteen nominal species, though not all reported have been taken up by Giesenhagen in his admirable monograph of the genus. This, however, is not an exhaustive treatment from a strictly taxonomic standpoint, containing some new things not properly correlated with that which is old. *Drynaria* similarly has ten nominal species, but the genus has never had a careful revision and all the species require very careful study afield. *Goniophlebium* has four species including the peculiar simple-leaved *Polypodium nummularium* on which Presl based his genus *Crypsinus* perhaps with good reason. *Polypodium* and *Phymatodes* have the largest representation in the islands, the former with nineteen nominal species and the latter with thirty-eight. It is probable that both these genera will receive extensive additions, particularly among the smaller epiphytic species that from their habitat longer evade detection. Such at least has been the experience in other tropical regions. Taken as a whole this tribe is one of the largest as well as one of the most characteristic groups of the Philippine fern flora.

#### Tribe 5. *Pterideae*

Maidenhair ferns are apparently less common in the Philippines than in most tropical regions and the entire tribe to which they belong with the exception of a single genus has a comparatively

\* The above synopsis follows exactly the lines noted in *Die natürlichen Pflanzenfamilien*, except that *Goniophlebium* and *Phymatodes* are there included under *Polypodium*, where in our judgment less attention has been given to venation than elsewhere in the work.

slight representation in the island flora. The several genera may be distinguished as follows:

- |   |               |
|---|---------------|
| 1. Sporangia attached to the under surface of marginal lobes; leafstalks black and shining. | ADIANTUM.     |
| Sporangia rising from a marginal vein-like receptacle.                                      | 2.            |
| Sporangia rising from the ends of unconnected veins; sori continuous or interrupted.        | 5.            |
| 2. Indusium double, the inner membranous, extrorse.   | 3.            |
| Indusium single.  | 4.            |
| 3. Leafstalks with several fibrovascular bundles.   | PTERIDIUM.    |
| Leafstalks with a single semicircular fibrovascular bundle.                                 | PAESIA.       |
| 4. Spores sphaero-tetrahedral.  | PTERIS.*      |
| Spores bilateral; leaves glaucous with auricled pinnae.                                     | HISTIOPTERIS. |
| 5. Leaves uniform.  | 6.            |
| Leaves dimorphous.  | 8.            |
| 6. Indusium continuous; stems black, polished.  | DORYOPTERIS.  |
| Indusium interrupted.   | 7.            |
| Indusium wanting.   | NOTHOLAENA.   |
| 7. Sori distant in sinuses of leaf.   | HYPOLEPIS.    |
| Sori crowded, more or less confluent.   | CHEILANTHES.  |
| 8. Leaves simply pinnate.   | PLAGIOGYRIA.  |
| Leaves decomposed.  | ONYCHIUM, †   |

Of the above genera *Paesia* and *Histiopteris* are each represented by a single Philippine species, *Onychium*, *Pteridium*, *Doryopteris*, *Hypolepis*, and *Notholaena* by two each, and *Cheilanthes* and *Plagiogyria* by three each. *Adiantum* has six representatives, of which one and possibly two are introduced species, while over twenty species of *Pteris* have been reported. The latter genus, and particularly its larger species, require careful field study; the peculiar tripartite branching of the larger species should be specially noted.

#### Tribe 6. *Asplenieae*

Next to the Polypodieae this tribe forms the most extensive portion of the Philippine fern flora; the thirteen genera represented may be distinguished as follows:

- |                                  |    |
|----------------------------------|----|
| 1. Sori parallel to the midribs. | 2. |
| Sori oblique to the midribs.     | 5. |

\* We have taken up *Pteris* as treated by Diels, *l. c.*, including species with both free and anastomosing veins. These have been separated by Presl and others, and further study will doubtless prove that they were correct.

† Diels following Prantl unites this with *Cryptogramma*, for which we can see no valid reason.

- |   |               |
|---|---------------|
| 2. Indusium wanting; plants climbing; leaves dimorphous.  | STENOCHLAENA. |
| Indusium present; plants mostly terrestrial.  | 3.            |
| 3. Leaves uniform.  | 4.            |
| Leaves dimorphous; sori intramarginal; caudex sometimes arborescent.  | STEGANIA.*    |
| 4. Veins anastomosing between the sori and the margin.  | WOODWARDIA.   |
| Veins free between the sori and the margin.   | BLECHNUM.     |
| 5. Indusium wanting.  | 6.            |
| Indusium present.   | 8.            |
| 6. Veins free.  | 7.            |
| Veins anastomosing.   | HEMIONITIS.†  |
| 7. Sori forked, with the forking of the veins.  | CONIOGRAMME.‡ |
| Sori simple, linear.  | SYNGRAMMA.‡   |
| 8. Veins free.  | 9.            |
| Veins anastomosing.   | 10.           |
| 9. Sori confined to one side of a vein, linear or slightly curved.  | ASPENIUM.§    |
| Sori curved or horseshoe-shaped, crossing to both sides of the veins.   | ATHYRIUM.§    |
| Sori double, the indusia opening on both sides of some of the veins.  | DIPLAZIUM.    |
| Sori rising from a special receptacle midway between veins; indusia attached to the veins, opening toward each other. | TRIPHLEBIA.   |
| 10. Veins connected only at their apices; leaves simple, densely clustered.   | THAMNOPTERIS. |
| Veins forming regular areolae.  | CALLIPTERIS.¶ |

*Woodwardia*, *Hemionitis* and *Coniogramme* are each represented in the Philippines by a single species, *Triphlebia* and *Syn-*

\* Diels unites this with *Blechnum*, although under the name *Lomaria* the genus is held as distinct even in *Synopsis Filicum*. The name *Struthiopteris* must hold for the European and North American representative of the genus (*S. Spicant*) and *Lomaria* had for its type a member of another genus, so must be replaced by *Stegania* R. Br., if generic distinctness from the North Temperate representatives is maintained.

† *Hemionitis* is associated in *Die natürlichen Pflanzenfamilien* with the Pterideae, with which it appears to have no near relationship; it must either form a tribe by itself or be associated here with its nearest but not very close allies.

‡ *Coniogramme* and *Syngramma* form a part of the heterogeneous *Gymnogramme* of *Synopsis Filicum*; Diels associated them with the Pterideae, for which we can see no warrant.

§ It is still an open question as to what we shall consider the generic types of these two genera; they are adopted here tentatively in their usually accepted sense.

|| The "bird's nest fern"; united with *Asplenium* by both Diels and Baker.

¶ The earlier name for *Anisogonium* Presl. Diels unites it with the free-veined *Diplazium* and both are joined as sections of *Asplenium* in *Synopsis Filicum*. *Allantodia* of *Synopsis Filicum* is also reported from the Philippines, but the name cannot hold for the species to which it is assigned and the genus is not clearly distinguished from *Callipteris*.

*gramma* by two each, *Stenochlaena*, *Thamnopteris* and *Athyrium* by four each, *Stegania* by five, and *Blechnum* by six; the larger genera are *Callipteris* with twelve species, *Diplazium* with twenty-one, and *Asplenium* with thirty-three. These numbers, however, represent nominal species and yet are not likely to be much reduced, and will be varied only by future discoveries.

#### Tribe 7. *Dipterideae*

This tribe is represented only by a single species of the curious fan-shaped *Dipteris*, perhaps one of the most unique among the ferns of the islands. Its leaves are often two or three feet broad.

#### Tribe 8. *Dryopteridace*

Related to our wood-ferns are a large number of species in all tropical regions and the Philippines come in for their share. The sixteen genera are distinguished as follows:

- |   |                |
|---|----------------|
| 1. Veins normally free, simple, forked, or pinnately branched.  | 2.             |
| Veins connivent, <i>i. e.</i> , the branches from contiguous pinnate groups uniting to form one or more arches. | 4.             |
| Veins copiously anastomosing.   | 6.             |
| 2. Leaves dimorphous; sori extending from the veins to the parenchyma so as to appear continuous.               | 11.            |
| Leaves uniform or nearly so.  | 3.             |
| 3. Indusium wanting; margins of segments plane.   | PHEGOPTERIS.   |
| Indusium circular, peltate.   | 8.             |
| Indusium oval, attached by a central axis to a thickened linear receptacle.                                     | DIDYMOCHLAENA. |
| Indusium cordate-reniform, attached by the sinus; veins distinct.   | DRYOPTERIS.    |
| 4. Indusium wanting.  | 5.             |
| Indusium cordato-reniform, attached by the sinus.   | CYCLOSORUS.    |
| 5. Sori round, punctiform.  | GONIOPTERIS.   |
| Sori elongate on the more or less parallel transverse arches.   | MENISCIUM.     |
| 6. Indusium wanting.  | 7.             |
| Indusium cordato-reniform, attached by the sinus.   | 9.             |
| Indusium orbicular, centrally peltate.  | 10.            |
| 7. Leaves dimorphous; sori extending to parenchyma so as to appear continuous.                                  | 12.            |
| Leaves uniform.   | ARCYPTERIS.*   |

\* The genus *Dictyopteris* Presl (1836) is antedated by a genus of the same name among the algae. We therefore propose the name **Arcypteris**, with the same meaning. It is not the exact equivalent of *Dictyopteris* Presl, the first species of which was *Polypodium attenuatum* R. Br., which does not belong to the § *Dictyopteris* as taken up by *Synopsis Filicum*. *Aspidium difforme* Blume! (Enum. Pl. Jav. 160. 1828) may be considered as the type of *Arcypteris*.

8. Pinnae continuous with the rachis ; texture firm, more or less coriaceous. POLYSTICHUM.  
Pinnae articulated with the rachis, easily caducous ; texture thin herbaceous. CYCLOPELTIS.
9. Areolae irregular, without free veinlets. PLEOCNEMIA.  
Areolae provided with free recurrent veinlets. SAGENIA.
10. Areolae regular ; included veinlets straight, directed towards the margins of the segments. CYRTOMIUM.  
Areolae irregular, fine ; included veinlets often branched and recurrent. TECTARIA.
11. Rootstock short. EGENOLFIA.  
Rootstock widely climbing. POLYBOTRYA.
12. Areolae few, without free included veinlets. STENOSEMIA.  
Areolae copious, with free included veinlets. ANAPAUSIA.\*

The disposition of these genera by Hooker and Baker and by Diels is so diverse that it can be best represented in tabular form :

Genera here accepted	Number of Philippine species reported	Equivalent genera in <i>Die natürlichen Pflanzenfamilien</i>	Equivalent genera in <i>Synopsis Filicum</i>
Phegopteris	9	Nephrodium	Polypodium
Polystichum	9	Polystichum	Aspidium
Cyclopeltis	1	Cyclopeltis	Aspidium
Didymochlaena	1	Didymochlaena	Didymochlaena
Dryopteris	44	Nephrodium	Nephrodium
Cyclosorus	24	Nephrodium	Nephrodium
Goniopteris	6	Nephrodium	Polypodium
Meniscium	2	Nephrodium	Meniscium
Arcypteris	5	Nephrodium	Nephrodium
Pleocnemia	5	Nephrodium	Nephrodium
Sagenia	9	Aspidium	Nephrodium
Cyrtomium	1	Polystichum	Aspidium
Tectaria	7	Aspidium	Aspidium
Egenolfia	1	Polybotrya	Acrostichum
Polybotrya	5	Polybotrya	Acrostichum
Stenosemia	1	Stenosemia	Acrostichum
Anapausia	12	Gymnopteris	Acrostichum

#### Tribe 9. *Oleandreae*

This tribe is represented in the Philippines by four nominal species of *Oleandra*, the only genus in the tribe. Their satiny luster renders them peculiarly attractive among ferns.

#### Tribe 10. *Woodsieae*

This tribe is represented in our eastern possessions only by one species of *Diacalpe*.

\* These have been usually placed in *Gymnopteris*, but that genus was monotypic as originally founded and based on a plant of a wholly different alliance.



Tribe 11. *Davallieae*

The eight genera represented may be distinguished as follows :

- |  |               |
|--|---------------|
| 1. Pinnae one-sided : indusium double, the inner membranous, the outer formed of the more or less changed leaf-margin. | LINDSAEA.     |
| Pinnae developed on both sides of midrib, though not always equally.   | 2.            |
| 2. Indusium attached only at base.   | 3.            |
| Indusium attached on three sides.  | 4.            |
| Indusium wanting ; sori subterminal on the veins.  | MONACHOSORUM. |
| 3. Pinnae jointed to the rachis.   | NEPHROLEPIS.  |
| Pinnae not jointed ; leaves jointed to the rootstock.  | HUMATA.       |
| Pinnae not jointed ; leaves not jointed to the rootstock.  | SACCOLOMA.    |
| 4. Leaves jointed to the rootstock.  | DAVALLIA.     |
| Leaves not jointed to the rootstock.   | 5.            |
| 5. Leaf-lobes as long as indusium and both uniting in a special cup beneath the sorus.                                 | DENNSTAEDTIA. |
| Leaf-lobes slightly modified, longer than the indusium.  | 6.            |
| 6. Sorus with a receptacle containing tracheids ; leaves scattered on a creeping rootstock.                            | MICROLEPIA.   |
| Sorus without a tracheidal receptacle ; leaves clustered.  | ODONTOSORIA.  |

The Malaysian region is the home of certain groups of the davalloid ferns ; *Humata* is represented by twelve species ; *Davallia* also by twelve species, of which six belong to the § *Odontoloma*, sometimes recognized as a genus ; *Odontosoria* by a single species, and *Microlepia* by nine ; all the foregoing are included in the genus *Davallia* in *Synopsis Filicum*. Of the other genera *Nephrolepis* has eight nominal Philippine species, a number which may be modified, since the genus is sadly in need of a revision ; *Lindsaea* has seventeen, *Dennstaedtia* has four, and *Monachosorum* and *Saccoloma* each one.

## FAMILY 7. HYMENOPHYLLACEAE

Following the usual treatment the filmy ferns are grouped in two genera representing the primary divisions in the following synopsis. We believe, however, that many of the genera established by Presl are as clearly marked natural groups as can exist among the ferns, and in the following treatment we have taken up such of Presl's genera as occur in the Philippines, believing that others represented in tropical America and elsewhere represent equally natural groups.

The Philippine genera are as follows:

- |  |                 |
|--|-----------------|
| 1. Indusium tubular; receptacle filiform exserted. ( <i>Trichomanes</i> Syn. Fil.)   | 2.              |
| Indusium 2-valved, formed of two divided laminae of the leaf; receptacle shorter than the indusium or barely protruding. ( <i>Hymenophyllum</i> Syn. Fil.) | 6.              |
| 2. Margin of the indusium entire.  | 3.              |
| Margin of the indusium 2-lipped.   | 5.              |
| 3. Receptacle terminating in a rounded head.   | CEPHALOMANES.*  |
| Receptacle uniformly terete.   | 4.              |
| 4. Leaves and indusia bordered by rows of minute cells.  | ABRODICTYUM.†   |
| Leaves of uniform texture not bordered.  | TRICHOMANES.    |
| 5. Indusium contracted below the lips, bordered by the tissue of the leaf.   |                 |
|  | DIDYMOGLOSSUM.‡ |
| Indusium lateral, subpedicellate, not contracted nor bordered.   | MERINGIUM.§     |
| 6. Receptacle clavate; leaves smooth; sporangia sessile.   | HYMENOPHYLLUM.  |
| Receptacle globose-thickened at the summit; leaves often covered or margined with simple or stellate hairs, sometimes smooth; sporangia stipitate.         |                 |
|  | SPHAEROCIONIUM. |

Of the above genera *Cephalomanes*, *Abrodictyum*, and *Meringium* are each represented by a single species, *Sphaerocionium* and *Didymoglossum* by six each; *Hymenophyllum* still has a residue of fourteen species, and *Trichomanes* a still larger one of twenty-four. There has been no modern monograph of this family, so that these numbers are likely to be varied greatly aside from future additions to the flora.

#### IV. SALVINIALES

Both families of this order are represented in the Philippines: the floating Salviniaceae by a single species of *Azolla*, and the rooting Marsileaceae by a single species of *Marsilea* with the usual

\* *Cephalomanes* Presl, Hymenophyllaceae, 17. pl. 5. 1843. Monotypic; based on *C. atrovirens* Presl (Luzon, *Cuming*, no. 169); there was evidently a mixture in this number, for Hooker in commenting on Presl's genera says that his plant under that number is *Trichomanes javanicum*. Presl later defends his genus in vigorous language and adds other species, and the genus was accepted by Van den Bosch.

† *Abrodictyum* Presl, Hymenophyllaceae, 20. pl. 7. 1843. Monotypic; based on *A. Cumingii* Presl (Luzon, *Cuming*, nos. 208, 358).

‡ *Didymoglossum* Desv. Ann. Soc. Linn. Paris, 6: 330. 1827. Based on *Trichomanes muscoides* Sw. (first named) and seven other species.

§ *Meringium* Presl, Hymenophyllaceae, 21. pl. 8, f. B. 1843. Based on two species, of which *M. Meyenianum* Presl (Luzon, *Meyen*) is named as type.

|| *Sphaerocionium* Presl, Hymenophyllaceae, 33. pl. 4, f. B; pl. 10, f. B, C. 1843. Based on *Hymenophyllum hirsutum* Sw. (first named) and numerous other species.

quadripartite foliage characteristic of the genus. The species of *Marsilea* grow in wet places and often resemble in habit small plants of *Oxalis*.

#### V. EQUISETALES

This order of a single family has at present one known representative in the Philippines, *Equisetum debilis*, also found in south-eastern Asia.

#### VI. LYCOPODIALES

All three of the families of this order are represented in the Philippines. They may be easily recognized as follows:

- |  |                     |
|--|---------------------|
| 1. Spores minute, of one sort.   | 2.                  |
| Spores of two sorts, minute microspores and larger macrospores; leaves (in all Philippine species) 4-ranked, of two sizes. | 3. SELAGINELLACEAE. |
| 2. Sporangia unilocular.   | 1. LYCOPODIACEAE.   |
| Sporangia 2-3-locular.   | 2. PSILOTACEAE.     |

The Lycopodiaceae are represented by thirteen species of *Lycopodium*, two of which are said to be species of the temperate or subboreal region of the United States, a statement which appears scarcely credible.

The Psilotaceae are represented by *Psilotum nudum* with leaves reduced to mere rudiments, and trilocular sporangia, and *Tmesipteris Tannensis* with oval leaves nearly an inch long and bilocular sporangia. The Selaginellaceae are represented by thirty-three species of *Selaginella*, the larger part of which have been added through the labors of Dr. Warburg.

#### SUMMARY

<i>Orders</i>	<i>Families</i>	<i>Genera</i>	<i>Species</i>
Ophioglossales	1	4	7
Marattiales	1	3	7
Filicales	7	91	568
Salviniales	2	2	2
Equisetales	1	1	1
Lycopodiales	3	4	48
Totals	15	105	633

The fern flora of the Philippines is evidently related on the one hand to that of Formosa and the Asiatic continent, and on the other to that of the more southerly islands of Celebes and Borneo; the extensive recent additions to the fern flora of the

latter island through the discoveries of Bishop Hose open up a series of interesting distributional problems relative to the southern islands of the Philippine group which have never yet been explored botanically. It is hoped that some American residents in the Philippines will become interested in the ferns of the islands and make extended studies of their interesting pteridophyte flora. We shall be only too glad to render any assistance in specific identification that may be sought in the hope that our knowledge of the fern flora of this prolific region may be thereby extended.

COLUMBIA UNIVERSITY, 1 November, 1903.

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Since the above article was in print I have learned of the publication of a paper by Mr. E. D. Merrill on the botanical work already accomplished in the Philippines, said also to give an account of the existing herbaria in the archipelago.—L. M. U.

## INDEX TO THE GENERA OF PHILIPPINE FERNS

- |                    |                       |                     |
|--------------------|-----------------------|---------------------|
| Abrodictyum, 681   | Dipteris, 678         | Onychium, 676       |
| Acrostichum, 673   | Doryopteris, 676      | Ophioderma, 669     |
| Actinostachys, 671 | Drymoglossum, 674     | Ophioglossum, 669   |
| Adiantum, 676      | Drynaria, 674         | Osmunda, 670        |
| Alcicornium, 673   | Dryopteris, 678       | Paesia, 676         |
| Alsophila, 672     | Dryostachyum, 674     | Phegopteris, 678    |
| Anapausia, 679     | Egenolfia, 679        | Photinopteris, 674  |
| Angiopteris, 669   | Elaphoglossum, 673    | Phymatodes, 675     |
| Antrophyum, 674    | Equisetum, 682        | Plagiogyria, 676    |
| Arcypteris, 678    | Goniophlebium, 675    | Platytaenia, 674    |
| Asplenium, 677     | Goniopteris, 678      | Pleocnemia, 679     |
| Athyrium, 677      | Helminthostachys, 669 | Polybotrya, 679     |
| Azolla, 681        | Hemionitis, 677       | Polypodium, 674     |
| Belvisia, 674      | Hemitelia, 672        | Polystichum, 679    |
| Blechnum, 677      | Histiopteris, 676     | Psilotum, 682       |
| Botrychium, 669    | Humata, 680           | Pteridium, 676      |
| Callipteris, 677   | Hymenophyllum, 681    | Pteris, 676         |
| Cephalomanes, 681  | Hypolepis, 676        | Saccoloma, 680      |
| Ceratopteris, 671  | Kaulfussia, 669       | Sagenia, 679        |
| Cheilanthes, 676   | Lecanopteris, 674     | Schizaea, 671       |
| Cheiropleuria, 673 | Lindsaea, 680         | Selaginella, 682    |
| Cibotium, 672      | Lophidium, 671        | Selliguea, 674      |
| Coniogramme, 677   | Lycopodium, 682       | Sphaerocionium, 681 |
| Cyathea, 672       | Lygodium, 671         | Stegania, 677       |
| Cyclopeltis, 679   | Marattia, 669         | Stenochlaena, 677   |
| Cyclophorus, 674   | Marsilea, 681         | Stenosemia, 679     |
| Cyclosorus, 678    | Meniscium, 678        | Syngamma, 677       |
| Cyrtomium, 679     | Meringium, 681        | Taenitis, 674       |
| Davallia, 680      | Microlepia, 680       | Tectaria, 679       |
| Dennstaedtia, 680  | Monachosorum, 680     | Thamnopteris, 677   |
| Diacalpe, 679      | Monogramma, 674       | Tmesipteris, 682    |
| Dicranopteris, 671 | Nephrolepis, 680      | Trichomanes, 681    |
| Didymochlaena, 678 | Notholaena, 676       | Triphlebia, 677     |
| Didymoglossum, 681 | Odontosoria, 680      | Vittaria, 674       |
| Diplazium, 677     | Oleandra, 679         | Woodwardia, 677     |